January 28, 1958

OHIO AGRICULTURAL EXPERIMENT STATION
Wooster, Ohio

Forestry Mimeograph No. 37

Plantation Studies in the Mohican State Forest, Ashland County, Ohio

by

John Aughanbaugh

- - - -

The Mohican State Forest near Loudonville, Ohio, contains a considerable acreage of excellent forest plantings comprised of various tree species in pure stands and in mixtures. During recent winters the Ohio Division of Forestry has been doing extensive pruning, thinning, and release cutting work throughout its oldest plantations there.

In 1952, the Forestry Department of the Ohio Agricultural Experiment Station, cooperating with the Ohio Division of Forestry, established three series of experimental sample plots within those plantings, as follows:

(a) Pure white pine, planted 1933 - 4 plots.

(b) Mixed white and red pines, planted 1936 and 1937 - 5 plots.

(c) Red pine and tuliptree, planted 1936 and 1937 - 4 plots.

Each of the 13 plots is 1/10-acre in size, but laid out inside a quarter-acre to provide isolation strips on its four sides. Some plots were treated intensively and the others left untreated to serve as controls. We plan to remeasure them periodically, and to carry on additional cultural work when needed. They were measured and treated last in October 1957, when diameter breast-high and total height were recorded for each tree. This is a progress report of our cultural studies and findings to date.

Pure White Pine Plantation No. 35

Here is an exceptionally find stand of straight, vigorous, rapidly growing white pines, now 25 years of age. It affords convincing evidence of the outstanding value of eastern white pine for reforestation on suitable sites over most of Ohio.

In 1952, four permanent plots, three treated and an untreated control, were established. The purpose of this experiment is to determine the effect of different thinning intensities upon diameter, height, and volume growth of the residual stand. Another objective is to demonstrate to plantation owners some cultural practices that improve the amount and value of their wood crop.

All pines on the treated plots were first pruned to 7 feet above ground. Crop trees, varying in number from 200 to 220 per acre, were then selected and high-pruned to 17 feet. These represent the "cream of the crop" and stand 15 to 20 feet apart. Thinning was done next to provide optimum growing conditions for the crop trees, by removing different numbers of competitors from the three treated plots.

Since the crown canopy had not reclosed yet by 1957, additional thinning then was unnecessary. Five years later, perhaps, more of the pines should be cut to assist various crop trees. The effect of release on growth for the five years following treatment is shown in the accompanying table.

Thinning has concentrated quality increment upon those favored high-pruned pines. In general, diameter growth was stimulated in proportion to the intensity of the thinning, but its effect on height growth seems negligible. Average crop trees already are larger by 0.1 to 0.6 inch of diameter, than similar trees on the untreated control plot. So they will reach merchantable size somewhat earlier than without thinning. The next five to ten years will show a much greater difference, particularly in the board foot content of the trees which advances rapidly with diameter. Hence progressively more and more knot-free wood will be put on fewer and fewer of the choicest pines.

A mean annual growth of 150 cubic feet, or more than 1½ cords per acre, is considered very good for a plantation so young. Further, it should increase gradually in amount for some years to come. Stand density, as expressed by basal area, is significantly greater now than before thinning, and its acceleration on treated plots has exceeded that on the control.

It is predicted that the total yield, after a number of excessive thinnings, will differ but little on any of these plots. Some loss even of gross wood production would have little significance as compared to the larger profits from clean, thrifty boles marketable sooner because of timely thinning and pruning.

Mixed White - Red Pine Plantation No. 79

Foresters have generally recommended mixed plantings of white and red pines on appropriate sites. The growth record of Plantation No. 79 indicates this to be a potentially successful plantation, but it attests also to the white pine's need of assistance to achieve the maximum harvest returns.

Everywhere in this alternate row mixture, white pine is losing out gradually in the competitive race between species. Its mean crown spread is consistently less than on red pine, thus providing it with less growing space both above and below ground. Summarized data depict it as having, if unaided, only 20 to 35 percent of the stand basal area and volume. On Plot 79-A, however, which in 1952 was thinned so as to favor the white pine, it now comprises 40 percent of the above-mentioned stocking criteria. For those reasons, our 1957 treatments have accorded the white pine preferential aid.

On three of the four treated plots, more white than red pine crop trees were chosen. Plot 79-E does not support enough white pine of suitable caliber for crop trees. Throughout this series, in fact, white pines of co-dominant rather than dominant crown class are the best available. Even after thinning, the red pine still holds an advantage of one to two inches in diameter and one to five feet in height, but on the control plot it excels by three inches in diameter and ten feet in height.

Single alternate row planting mixtures are today considered inadvisable, except for species of the same rate of height growth and on sites equally congenial to both of them. However, field experience indicates that those prerequisites seldom gibe. Better results can be had by planting the two species in alternate bands of three to five rows each, or else in small blocks arranged in a checkerboard pattern. Trees standing near the center of such bands or blocks have the best chance to mature.

Plot Series 35

White Pine, Planted 1933
(Data on Per Acre Basis)

Stand Development	Plot 35-A (C)		Plot 35-B (T)		Plot 35-C (T)		Plot 35-D (T)	
Year of Measurement	1952	1957	1952	1957	1952	1957	1952	1957
Age (Yrs.)	20	25	20	25	20	25	20	25
Crop Trees (No.)	-	-	220	220	220	220	200	200
Total Trees (No.)								
BT	600	590	680	430	660	550	590	440
AT	600	590	430	430	550	550	440	440
Basal Area (Sq.Ft.)								
BT	114.8	149.2	120.7	122.5	124.1	136.8	112.1	121.6
AT	114.8	149.2	76.3	122.5	96.9	136.8	85.0	121.6
Av. D.B.H. (Ins.)								
BT	5.9	6.8	5.9	7.2	5.9	6.7	5.9	7.1
AT	5.9	6.8	5.7	7.2	5.7	6.7	5.9	7.1
Av. Height (Ft.)								
BT	36.0	42.4	35.0	39.9	36.0	40.2	36.0	38.3
AT	36.0	42.4	36.0	39.9	36.0	40.2	37.0	38.3
Volume (Cu.Ft.)*								
BT	2122	3744	2176	3051	2334	3323	2086	2940
AT	2122	3744	1476	3051	1888	3323	1616	2940
Yield to Date	2122	3744	2176	3751	2334	3769	2086	3411
Av. Annual Growth(Cu.Ft.)**	106.1	149.8	108.8	150.0	116.7	150.8	104.3	136.4

C - Control T - Treated BT - Before Thinning

AT - After Thinning. D.B.H. - Diameter at Breast Height ($4\frac{1}{2}$ ft. above ground)

* Total volume, outside bark; includes dead standing trees.

** After 20 and 25 growing-seasons.

Mixed Red Pine-Tuliptree Plantation No. 81

This is an interesting type of mixed planting, and one which is seldom seen. It too is a single alternate row mixture, but of a semi-tolerant conifer with a light-demanding hardwood. And like the preceding plantation, one of its associate species, here the tuliptree, is being crowded out, due undoubtedly to its inability to withstand shade.

One is surprised, however, to see the tuliptree, the so-called "gentleman of the forest", doing even this well on an abandoned field site. Many a similar planting venture has ended in early failure, for this species is notoriously exacting in its demands upon soil fertility and moisture. Perhaps these old fields were not too severely eroded, prior to their being planted to trees.

Plot Series 79

White & Red Pines, Planted 1936 and 1937
(Data on Per Acre Basis)

Stand Development	Plot 79-A (T)			Plot 79-B (T)			Plot 79-C (C)			Plot 79-D (T)			Plot 79-E (T)		
Yr. of Measurement	1957			1957			1957			1957			1957		
Species	R.P.	W.P.	All	R.P.	W.P.	All	R.P.	W.P.	All	R.P.	W.P.	All	R.P.	W.P.	All
Crop Trees(No.)	60	150	210	90	140	230	-	-	-	110	120	230	170	60	230
Total Trees(No.)															
BT	220	340	560	360	290	650	290	350	640	410	280	690	350	230	580
AT	210	310	520	260	220	480	290	350	640	260	200	460	290	170	460
Basal Area(Sq.Ft.)															
BT	66.1	43.9	110.0	95.0	42.8	137.8	77.8	34.3	112.1	83.9	39.0	122.9	89.6	22.3	111.9
AT	63.5	43.6	107.1	76.8	38.5	115.3	77.8	34.3	112.1	67.9	36.6	104.5	82.5	21.9	104.4
Av.D.B.H.(Inches)															
BT	7.4	4.9	6.0	7.0	5.2	6.2	7.0	4.2	5.7	6.1	5.0	5.7	6.9	4.2	5.9
AT	7.4	5.1	6.1	7.3	5.7	6.6	7.0	4.2	5.7	6.9	5.8	6.5	7.2	4.9	6.5
Av. Height(Feet)															
BT	34.6	29.9	31.9	36.8	33.3	35.3	35.8	25.4	30.1	33.3	31.4	32.5	34.7	27.2	31.7
AT	35.6	30.9	32.8	37.6	36.8	37.3	35.8	25.4	30.1	35.1	36.1	35.5	36.0	32.8	34.8
Volume(Cu.Ft.)*															
BT	1247	796	2043	1961	824	2785	1518	794	2312	1495	754	2249	1704	404	2108
AT	1215	792	2007	1547	769	2316	1518	794	2312	1266	725	1991	1590	401	1991
Yield to Date	1573	796	2369	1961	824	2785	1518	794	2312	1495	754	2249	1704	404	2108
Av. Annual Growth (Cu.Ft.)**	-	-	107.7	-	-	126.6	-	-	105.1	-	-	102.2	-	-	95.8

C - Control T - Treated R.P. - Red Pine W.P. - White Pine BT - Before Thinning

AT - After Thinning

* - Total volume, outside bark: includes dead standing trees.

** - After 22 growing seasons.

Plot Series 81

Red Pine & Tuliptree, Planted 1936 and 1937
(Data on Per Acre Basis)

Stand Development	Plot 81-A (C)			Plot 81-B (T)			Plot 81-C (C)			Plot 81-D (T)		
Year of Measurement	1957			1957			1957			1957		
Species	R.P.	Tu.	All	R.P.	Tu.	All	R.P.	Tu.	All	R.P.	Tu.	All
Total Trees(No.)												
BT	390	420	810	370	250	620	520	250	770	490	330	820
AT	390	420	810	260	250	510	520	250	770	280	280	560
Basal Area(Sq.Ft.)												
BT	92.3	44.5	136.8	99.6	26.3	125.9	150.4	10.4	160.9	125.2	27.0	153.2
AT	92.3	44.5	136.8	68.9	26.3	95.2	150.4	10.4	160.9	66.4	25.1	91.5
Av.D.B.H.(Inches)												
BT	6.6	4.4	5.6	7.0	4.4	6.1	7.3	2.8	6.2	6.9	3.9	5.8
AT	6.6	4.4	5.6	7.0	4.4	5.8	7.3	2.8	6.2	6.6	4.1	5.5
Av. Height(Feet)												
BT	39.5	41.2	40.4	38.4	37.7	38.1	38.5	25.1	34.2	40.7	35.5	38.6
AT	39.5	41.2	40.4	38.2	37.7	38.0	38.5	25.1	34.2	40.2	36.7	38.5
Volume(Cu.Ft.)*												
BT	1968	998	2966	2059	537	2596	3099	154	3253	2655	500	3155
AT	1968	998	2966	1415	537	1952	3099	154	3253	1353	464	1818
Yield to Date	1968	998	2966	2310	556	2866	3099	154	3253	2655	500	3155
Av. Annual Growth (Cu.Ft.)**	-	-	134.8	-	-	130.3	-	-	147.8	-	-	143.4

C - Control T - Treated R.P. - Red Pine W.P. - White Pine BT - Before Thinning

AT - After Thinning

* - Total volume, outside bark. ** - After 22 growing seasons.

The humus here is noticeably softer and more friable than in the pure coniferous types located nearby. Rapid disintegration of the tuliptree's leaf litter tends to improve steadily the forest growing conditions on whatever site it happens to occur. Its leaves mix with the pine needles on the ground and thus reduce the acidity and increase the fertility of the soil.

While doing pruning in this plantation, we noted the heavy limb development on the red pines. It has doubtless resulted from the light side shade cast by the tuliptrees. Limbs of the latter were, in striking contrast, small and easily removed, for each sizable tuliptree has been treated and regarded as a potential crop tree.

Originally there were two plots, a treated and a control, in this series. Those were replicated, with the new plots 81-C and 81-D, in October 1957. At that time the treated plots were heavily thinned, in an effort to save the tuliptree from further suppression, or elimination. They were thinned "from above"; that is, by removing the largest red pines, to let in the maximum of sunlight to the tuliptrees.

Wherever it grows, the tuliptree is emphatically light-demanding. If unable to keep a position in the upper crown level of a stand, it loses vigor and succumbs for lack of sunlight. Its superlative characteristics make it a highly desirable tree to be encouraged within Ohio's farm woods and plantations but more information on its silvical requirements are needed.

- - - -